Canada Alberta

FOREST RESOURCE DEVELOPMENT AGREEMENT
ENTENTE SUR LA MISE EN VALEUR DES RESSOURCES FORESTIERES

Canada Alberta

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The Canada-Alberta Forest Resource Development Agreement is a subsidiary agreement of the Canada-Alberta Economic and Regional Development Agreement, which provides coordination and cooperation between the governments of Alberta and Canada in areas of Alberta's economic development.

The Canada-Alberta Forest Resource Development Agreement is funded equally by the governments of Canada and Alberta, from April 1, 1984, to March 31, 1989.

Its primary objectives are to ensure the long-term availability of timber supplies; to optimize timber uses; and to contribute to the growth and diversification of Alberta's economy.

The Agreement comprises three programs: Reforestation; Applied research, technology transfer and opportunity identification; and Public information, evaluation and administration. These programs are managed by a joint Directorate and are implemented by the Canadian Forestry Service and the Alberta Forest Service.

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Ses objectifs principaux sont assurer la disponibilité à long terme de réserves de bois; optimiser leur utilisation; et contribuer à la croissance et la diversification de l'économie de la province.

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BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION OF THE FORESTRY PORTION OF SOUTHWESTERN ALBERTA

Forest Research Branch
Alberta Forest Service
1987

Bela Sivak

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ABSTRACT

Through a cooperative effort of the Alberta Forest Service and the Canadian Forestry Service, biogeoclimatic ecosystem classifications have been carried out in Alberta over a period of eleven years. The objectives of the project(s) were to classify Alberta's forests first into zones (and subzones), secondly, to identify forest ecosystems within zones and subzones as a basis for forest management decisions.

The first joint effort between the Alberta Forest Service and the Canadian Forestry Service proceeded for four years (1976 - 1981), and attempted to develop the broad-scale framework of the site classification. The work was based on 439 experimental research plots established and described by field crews throughout Alberta.

The current biogeoclimatic ecosystem classification project, supported by the Alberta Forest Service, the Canada Alberta Forest Resource Development Agreement and the Job Development Program of Employment and Immigration Canada, has concentrated on the Bow-Crow and Rocky-Clearwater Forests. Through detailed field research it will clarify zone boundaries, identify forest ecosystems and develop management interpretations for each forest ecosystem, or for similar ecosystems within each zone. The field research has largely been completed for the Bow-Crow Forest. The data analyses and the development of management interpretations are in progress. The first approximation of the ecosystem guide, for the Bow-Crow Forest, will be completed in the current fiscal year. The ecosystem guide will be used by field staff to facilitate forest management decisions.

ACKNOWLEDGEMENTS

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During the 1987/88 field season the crew members were: Len Barnhardt, Wai-Lin Chee, Grant Klappstein, Karin Smith, Ted Burke, Craig Richter, Dena Lewis, John Beckingham, Thomas Buckler, Daryl Gilday, Terry Friederich, Raymond Chiu, Brian Melnyk, Steve Pentyliuk, Jamie Bruha and Dale Semotiuk. Others who contributed well to this project were Cindy Shaw and Dianne Prusak.

I am thankful to my colleagues in the Forest Research Branch for their support and Mrs. Reitha Sidor, Office Manager as well as Debbie Arcand, Secretary, for their outstanding efforts to keep this project moving.

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1. INTRODUCTION

The forests of Alberta have long been recognized as valuable components of the Province's natural resources. The forestry sector provides direct employment for 10,000 Albertans (Smith 1987) and, based on the study of Ondro and Williamson (1980), 23,000 Albertans indirectly. It is further significant that over one half of the timber resource has not been allocated for development (Smith 1987). "Non-forest uses such as watershed, wildlife, recreation will be on the rise and will soon become the determining considerations in the management of our mountain forests" (McDougall 1986).

The Hon. Don Getty, Premier of Alberta (1986), referred to the forest resources as one of the five pillars of Alberta's economy with energy, agriculture, research and technology and tourism. The use of this resource for its timber and wildlife values, grazing and recreation values are being increasingly appreciated. The value of this renewable resource is highlighted by the periodic faltering or cyclic performance of energy and agriculture, and by the very favourable overall trade balance shown by the forestry sector. From the foregoing it can be recognized with some confidence that the forest resources will play an increasingly important role in Alberta's economy.

In order to sustain the desired forest productivity a greater emphasis must be placed on forest management decisions founded on ecological principles. Probably, it was this type of consideration that supported the introduction of the biogeoclimatic ecosystem classification more than a decade ago. Certainly, today the need for an ecologically based forest management is recognized all across Canada more than at any other time in our history.

This report will deal with two site classification projects that have been jointly sponsored by the Alberta Forest Service, AFS and the Canadian Forestry Service, CFS over the last decade or longer.

1.1 Alberta Forest Service - Canadian Forestry Service biogeoclimatic forest classification project 1976-1981, and

1.2 Biogeoclimatic ecosystem classification of the Bow-Crow and Rocky-Clearwater Forests supported by the Canada-Alberta Forest Resource Development Agreement, Canadian Forestry Service and the Alberta Forest Service.

Each of these projects will be reviewed in terms of objectives, methods and results.

2. JOINT AFS-CFS BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION OF ALBERTA'S FORESTS

In 1976 the Forest Research Advisory Council of the Forest Development Research Trust Fund (FDRT) Committee recommended that funds be made available from the FDRT to undertake the biogeoclimatic ecosystem classification of Alberta's forest resources. The Deputy Minister of the Lands and Forests awarded the project to the Canadian Forestry Service (CFS) with the understanding that the CFS would commit two ecologists and two technicians to the projects. In addition, the FDRT agreed to contribute 2.2 man years of technical support and operating costs. The project was to continue over a period of three years with an annual operating budget of approximately $40,000.

The project objectives according to an internal progress report (Anon. 1983) submitted to the Assistant Deputy Minister of the AFS were:

a) to develop and provide an ecological classification of the forest ecocystems of Alberta

b) to provide basic information on the structure and characteristics of forest ecosystems.

c) to provide some interpretation of vegetation environment relationships in forest ecosystems.

d) to assist the province of Alberta in promoting application for the classification system in forest management practices and research programs.

2.1 Methodology

To accomplish these objectives the biogeoclimatic method developed by Dr. V.J. Krajina and his students was used. The reasons for selecting this method and the potential benefits stemming from its application in Alberta have been summarized by Kojima and Krumlik (1979). It's salient feature is that it subdivides large forested areas into broadly homogenous zones*

*The terminology used in this project is that of the biogeoclimatic ecosystem classification system. These are zones and subzones for small-scale categories and forest ecosystems for operational units. It is recognized that site classification terms used by different agencies vary and in order to promote technology transfer in the Alberta Forest Service, a simple and yet technically correct terminology will need to be adopted. This will require joint decision by site classification agencies in the near future. Since this report will not be used in technology transfer by field staff, the writer chose to use terminology consistent with the research proposal approved by the AFS-CFS research committee.

based on macroclimate, zonal soils or soil forming processes, vegetation, and productivity.

Within these broad zones, smaller units, called forest ecosystem, are identified based on features which modify macroclimate (slope and aspect), detailed soil description and analysis, topography, parent material, combinations of over and understory plant species, and tree productivity. Other investigators in Alberta (Corns and Annas, 1986) prefer and use the term ecosystem associations to name these units within zones.

Regardless of the term used, it is at this level of classification that the described units become an aid in forest land management.

2.2 Results

During the term of the project (1976-1980) 439 plots were located in the northwestern, western and southwestern forests (Anon. 1985). The distribution for these plots according to Forests is shown in Figure 1. Based on these field studies and additional reconnaissance work in the southwest by Kojima (1980) the first approximation of biogeoclimatic zones of southwestern Alberta was published.

Utilizing the same plot information, zone boundaries of the Subalpine zone and forest ecosystems of both southern (Lat. 49°N - Lat. 52° N) and northern subzones (Lat. 52°N - 54°N) were described by Kojima (1984, 1983). These zones and their forest ecosystems are shown in Figures 2 and 3.

Figure 1 shows the distribution of the Subalpine Zone in Southwestern Alberta. Its southern subzone extends from Latitude 49°N to 52°N. The forest ecosystems, called plant associations by Kojima (1989) are listed (upper right) as well as portrayed in the moisture-nutrient grid of that subzone (lower left). Figure 2 illustrates the northern subzone of the Subalpine Zone and its forest ecosystems in a similar manner. However, the study did not continue long enough to allow the development of management interpretations for each forest ecosystem.

Although the time-frame, manpower and the financial resources proved inadequate to accomplish the goals of the 4-year AFS-CFS biogeoclimatic project, the foundation was laid for future work. Indeed, data collecting using the biogeoclimatic format continued in CFS, the Resource Evaluation and Planning Branch, REAP and the Forest Research Branch, AFS. As a consequence much has been learned about Alberta's Forests as evidenced by the numerous published (Kojima and Krumlik 1977, Krumlik and Johnson 1987, Krumlik et al. 1978, Krumlik and Johnson 1979, Nemeth et al. 1980). An outstanding example of these publications is the guide for the identification and management of forest ecosystems in West-Central Alberta (Corns and Annas, 1986). This guide, now in the technology transfer

Figure 1. Distribution of research plots according to Forests described in the joint AFS-CFS research effort, 1976 - 1981

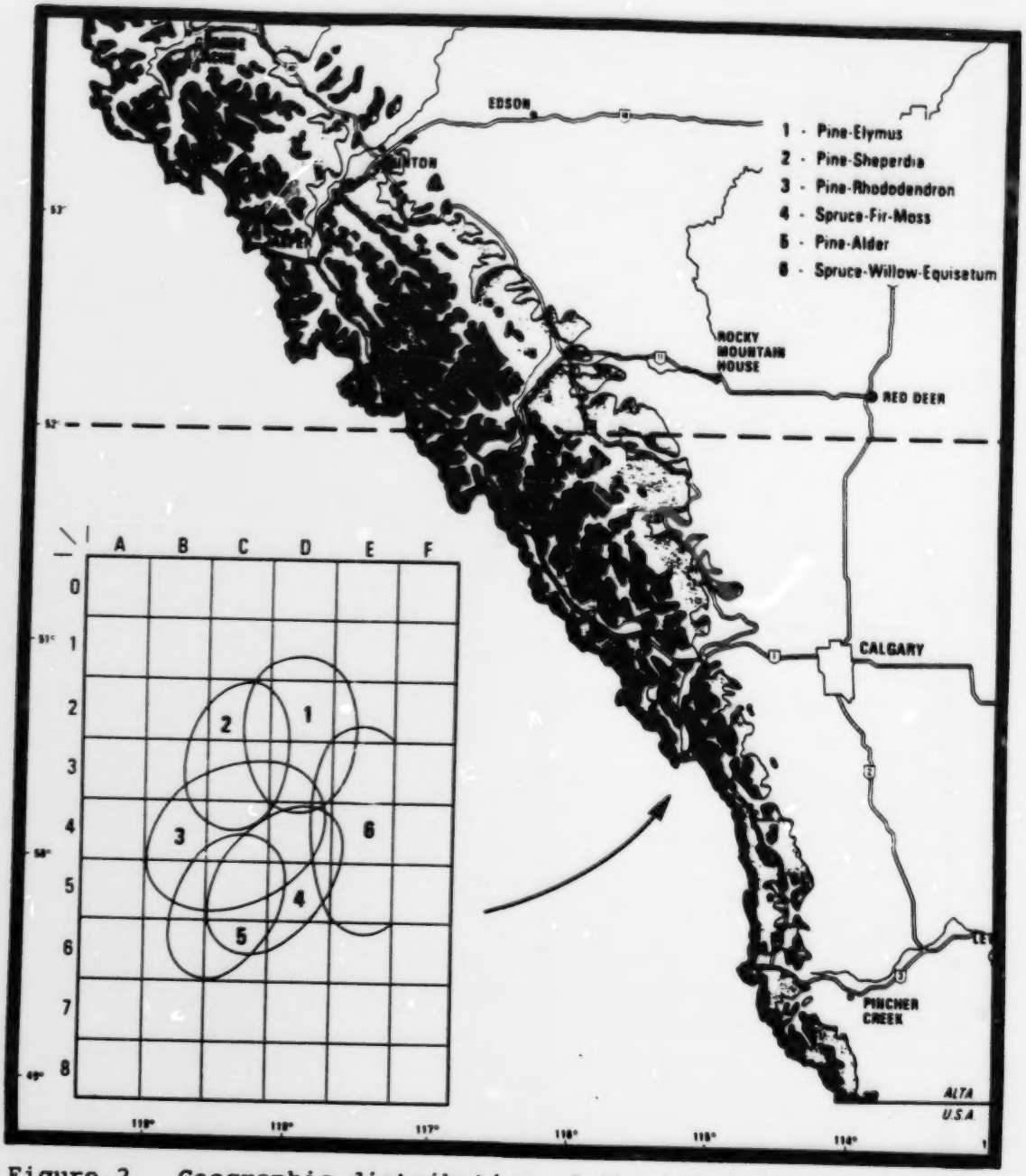


Figure 2. Geographic distribution of the Subalpine zone (light tone) and the Alpine Tundra Zone (dark tone) of Alberta (Kojima 1983). The southern subzone extend from Latitude 49°N to Latitude 52°N. The plant associations of this subzone are listed (upper right) and are shown in the moisture-nutrient grid (lower left).

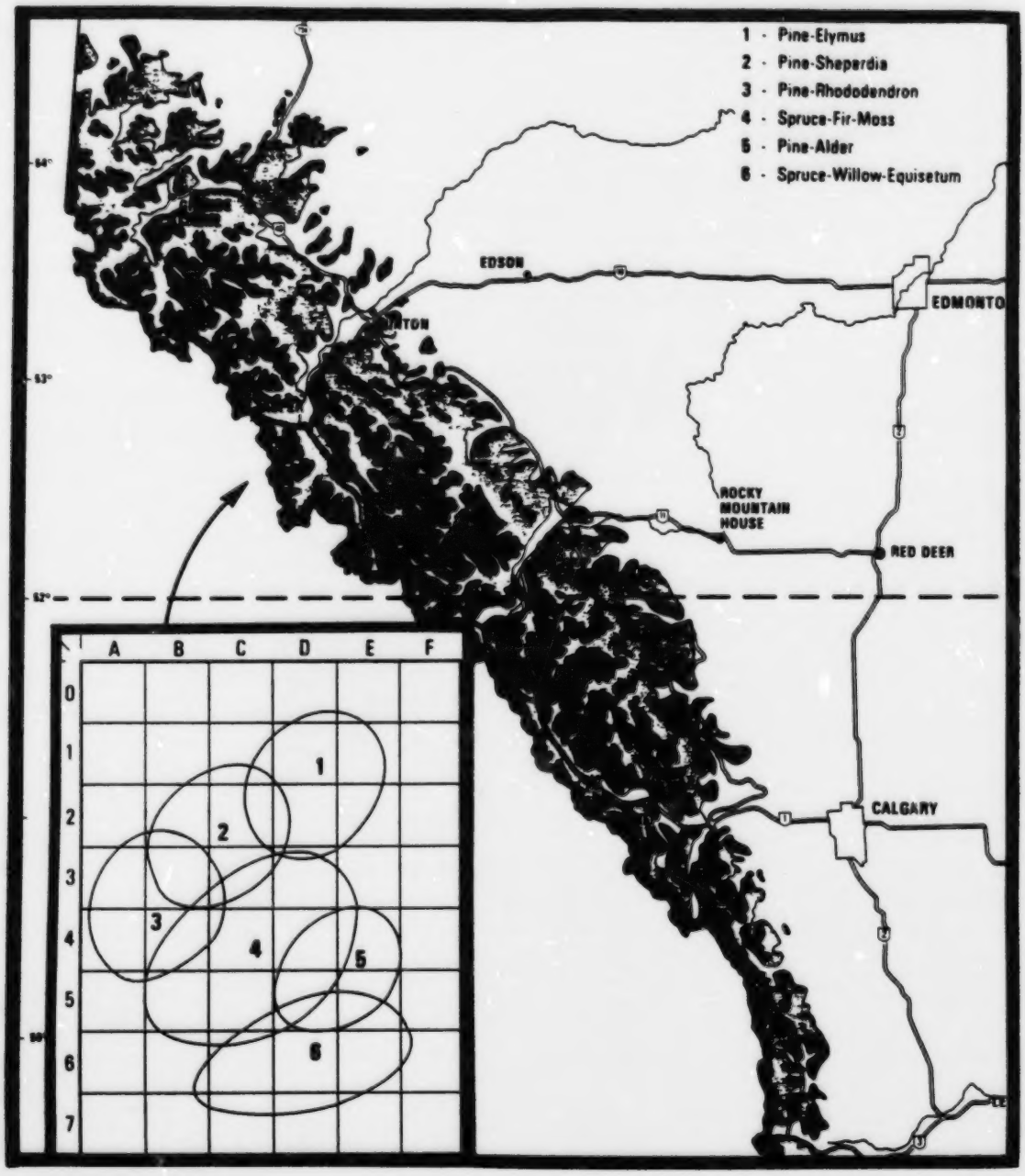


Figure 3. Geographic distribution of the Subalpine zone (light tone) and the Alpine Tundra Zone (dark tone) of Alberta (Kojima 1984). The northern subzone extends from Latitude 52°N to the Latitude 54°N. The plant associations of this subzone are listed (upper right) and portrayed in the moisture-nutrient grid (lower left)

phase, has its roots in these early AFS-CFS forest classification efforts.

3. FOREST SITE CLASSIFICATION IN THE BOW-CROW AND ROCKY-CLEARWATER FORESTS, 1986/87, 1987/88 and 1988/89

In 1986/87 the Forest Research Branch, with support from the Canadian Forestry Service resumed field research to develop the biogeoclimatic system classification for the Bow-Crow and Rocky-Clearwater Forests. The rationale to study these two Forests was 3-fold:

i) due to the early CFS-AFS data base available for these Forests the completion might be possible within a relatively short time frame.

ii) the completion of this project would help to refine integrated management plans.

iii) to identify high productivity forest sites, that in spite of the extensive allocation of forest land to non-forest uses, could promote regional forest industry and employment.

3.1 Objectives:

i) to clarify conflicting broad-scale subdivisions of southwestern forests (see Figures 4, 5, 6 and 7)

ii) through detailed field research characterize forest ecosystems in terms of productivity and required management treatments

iii) to develop specific management interpretations for each forest ecosystem or groups of similar forest ecosystems.

iv) to develop a field guide, modelled after that of Corns and Annas (1986) that would facilitate the use of the site classification information by field staff, students of universities and forest technology institutes.

3.2 Methods

Methods of the early CFS-AFS studies were used with slight modification. The modification included the use of soil data collected from pits dug to 1.0m or to bedrock and a more intensive soil sample collecting to deal with the high place-to-place variation of nutrients. Extensive field scouting was also carried out to aid the delineation of zone boundaries and the judicious location of experimental plots. The plot data is being analyzed using TWINSPAN, DECORANA programs imported from the

Ontario Ministry of Natural Resources and the COENOS program developed by Ceska and Roemer (1971) in British Columbia. Soil temperature measurements were initiated as a pilot project to assess heat units on zonal and azonal sites in Douglas fir, Montane, Subalpine and Boreal zones. The intent is to continue soil temperature measurements over a long period of time in order to supplement and augment the weak climatic data base.

3.3 Results

Clarification of conflicting zone boundaries

3.3.1 Figures 4, 5, 6 and 7 show some of the broadscale ecological maps for southwestern Alberta. We are hopeful that our vegetation, soil climate and the airphoto interpretation work, combined with field reconnaissance, will aid the reconciliation of these maps. The major disagreement revolves around the "boreal environment". Halliday (1937), Rowe (1972) as well as Strong and Leggat (1981) recognize the existence of "boreal environment" extending further south than it has been shown by Kojima (1980). Also, only Kojima (1980) recognizes the existence of a Douglas-fir Zone. As can be seen in Figure 7, Strong and Leggat (1981) designate the same geographic area (i.e. the Douglas-fir Zone of Kojima) as Montane Ecoregion. At present it would appear that the "boreal environment" may not extend as far south as most of the studies indicate. However, the analyses of data have not been completed and the final interpretation can not be made at this time.

3.3.2 Identification and characterization of forest ecosystems

Forest ecosystems are considered as homogeneous segments of the forest land in terms of soil (including parent material and topography), vegetation and local climate. These are the fundamental units to be used in forest management practices. Vegetation, soil, site, and mensuration data have been collected on 480 research plots. The distribution of these plots is shown in Figures 8, 9 and 10. The research plots are ordinated into similar groups to derive forest ecosystems. As mentioned earlier, the TWINSPAN and DECORANA programs are used for this purpose. Subsequently, soil and other environmental factors will be used to identify critical environmental and soil factors associated with the productivity of each forest ecosystem.

At present most of the ordination has been completed. Examples of this work are shown for two geographic areas, Montane-5 and Montane-6 and 7 as shown in Figures 11, 12 and 13. These geographic areas are arbitrarily defined along the south to north gradient to facilitate data handling.

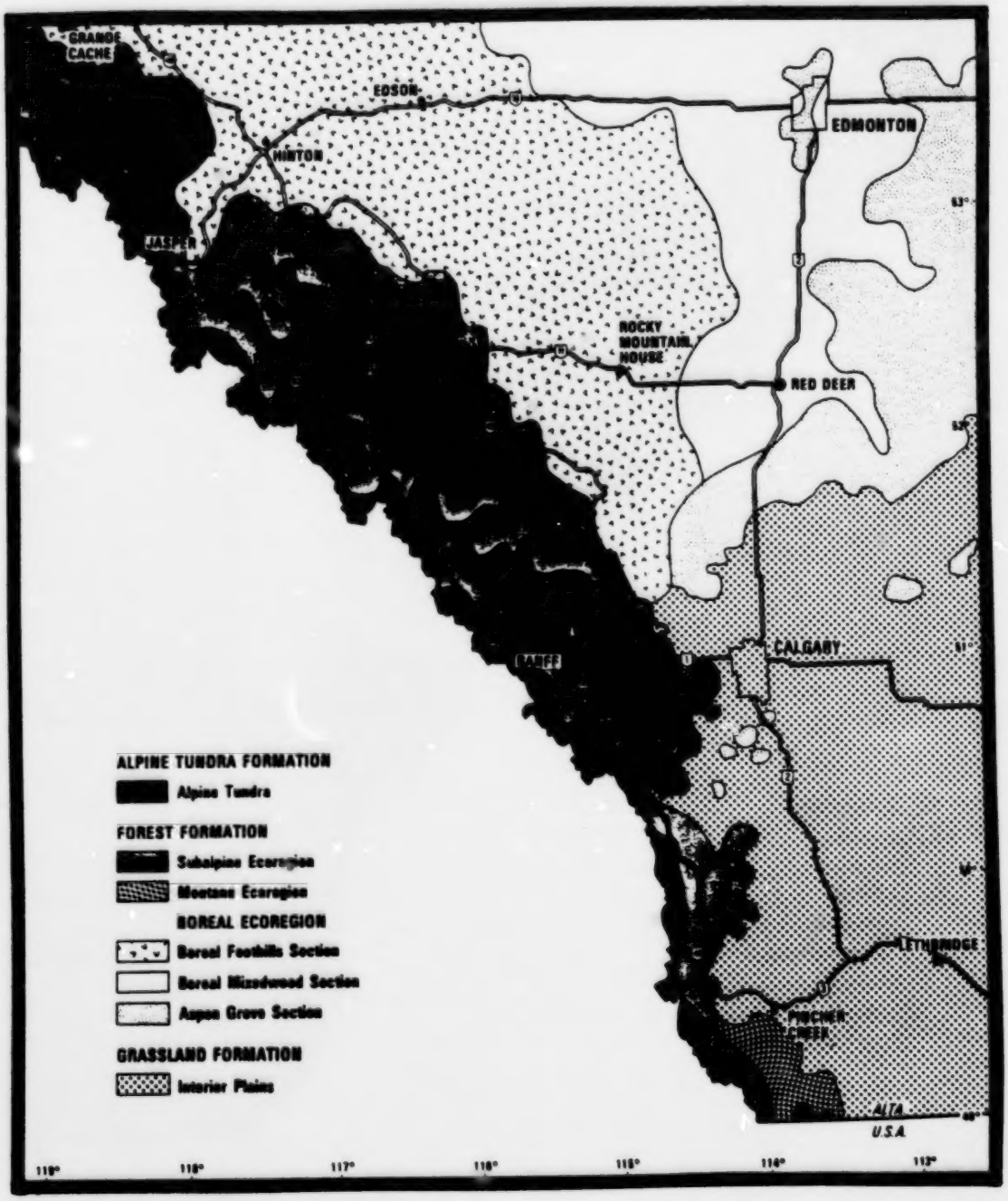


Figure 4. Forest regions of the Forest, the Tundra and Grassland Formations of Southwestern Alberta (Halliday 1937).

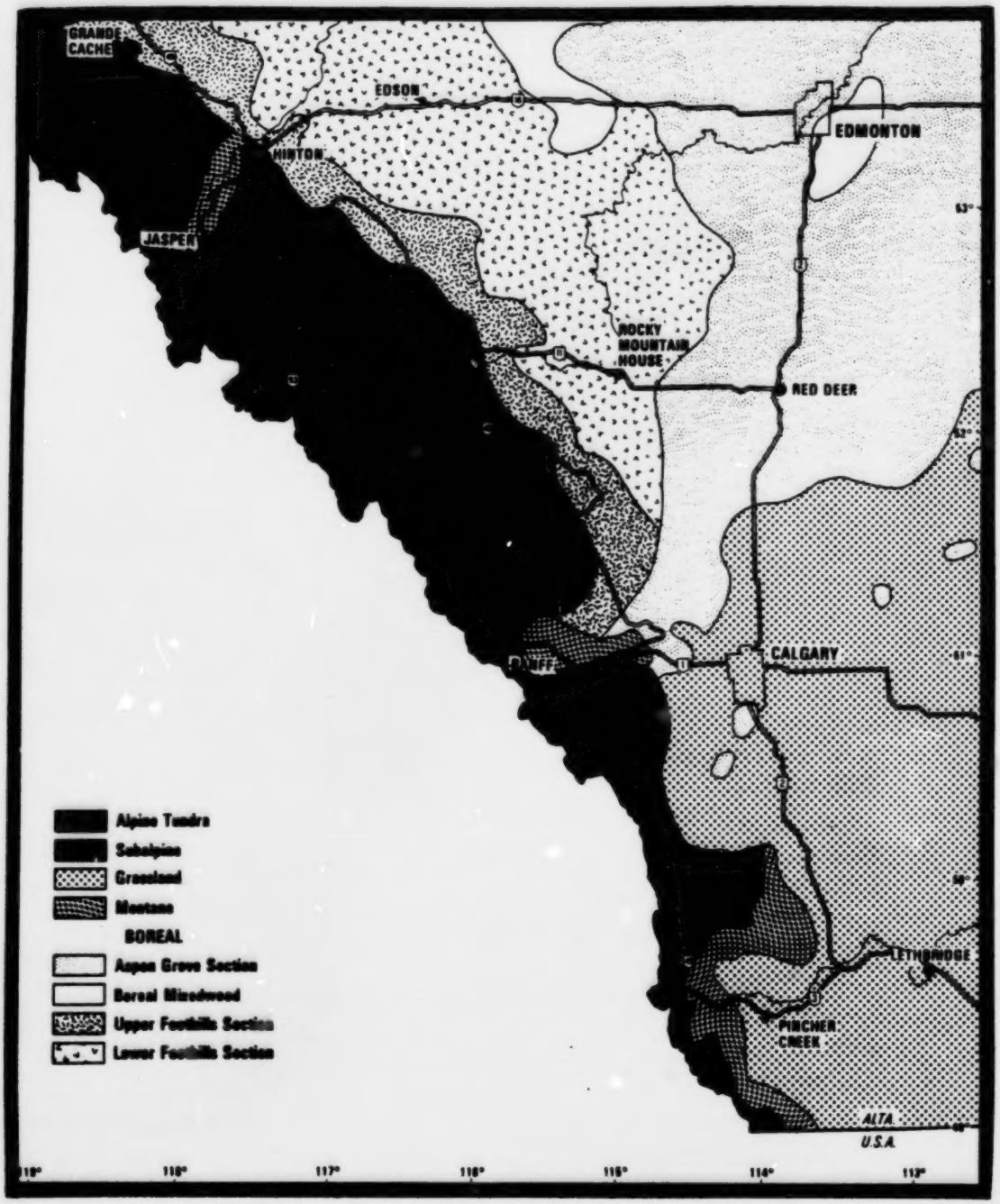


Figure 5. Alpine Tundra, Grasslands and forest regions in southwestern Alberta (Rowe 1972).

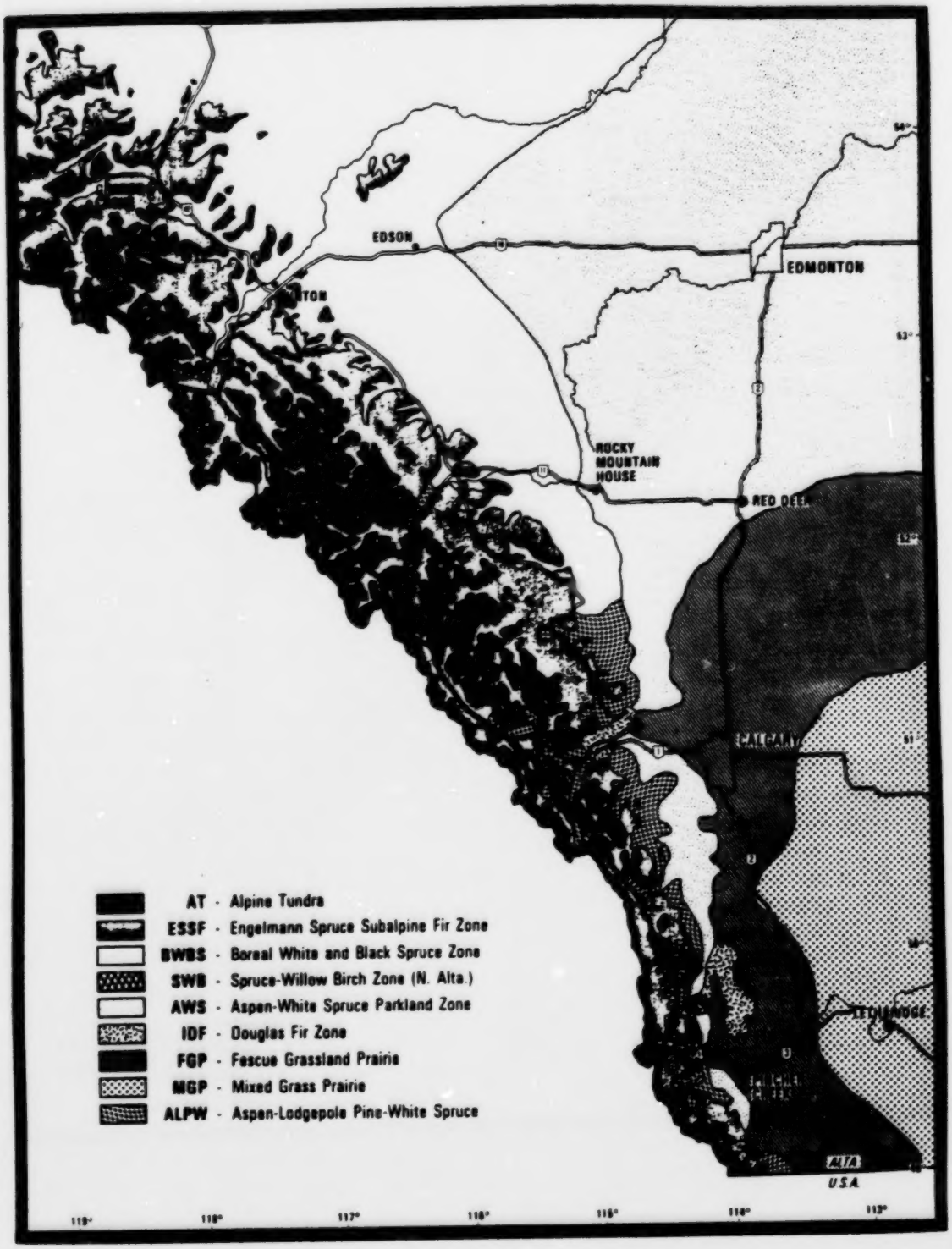


Figure 6. Distribution of biogeoclimatic zones in southwestern Alberta (Kojima 1980).

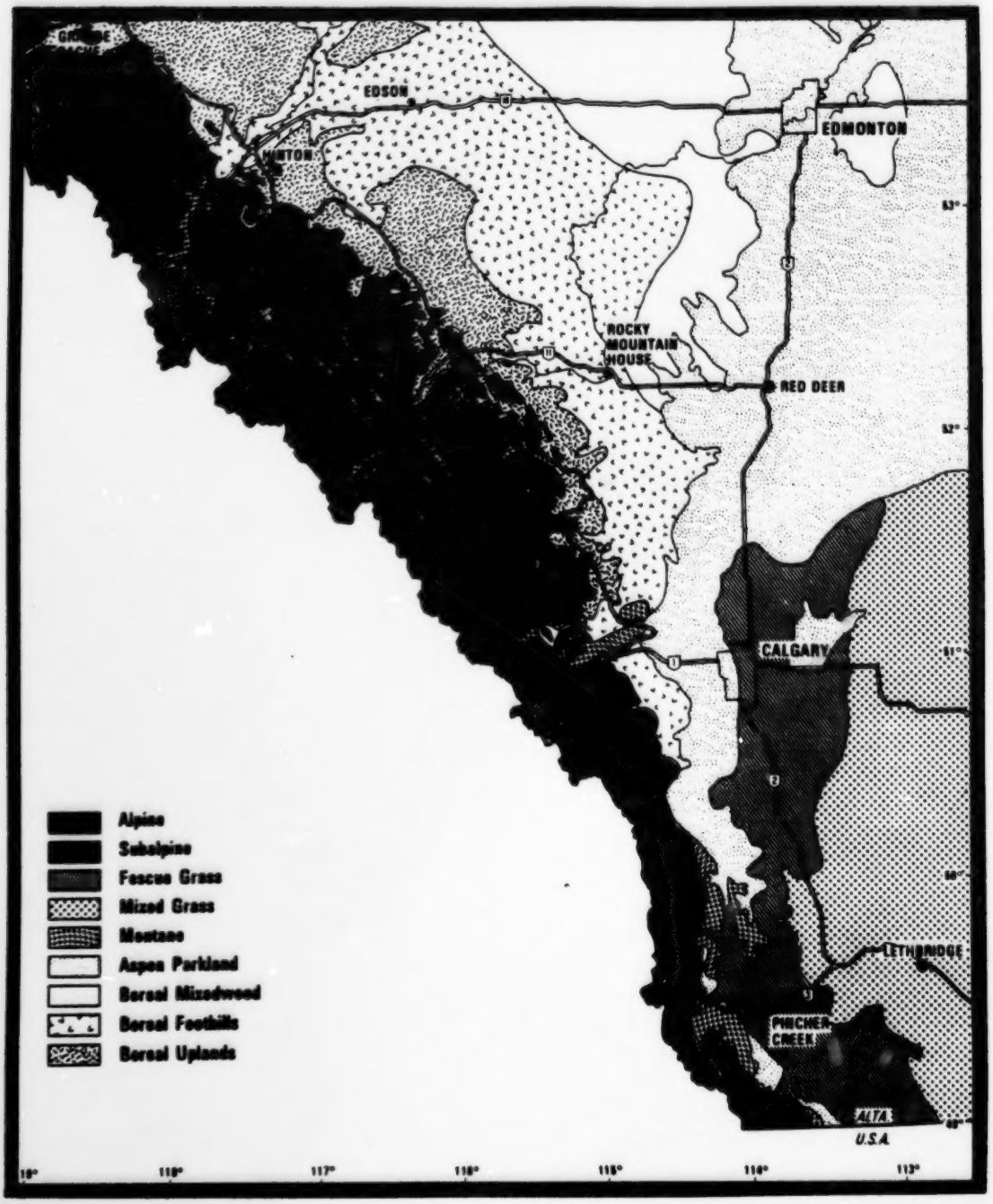


Figure 7. Distribution of ecoregions in southwestern Alberta (Strong and Leggat 1981).

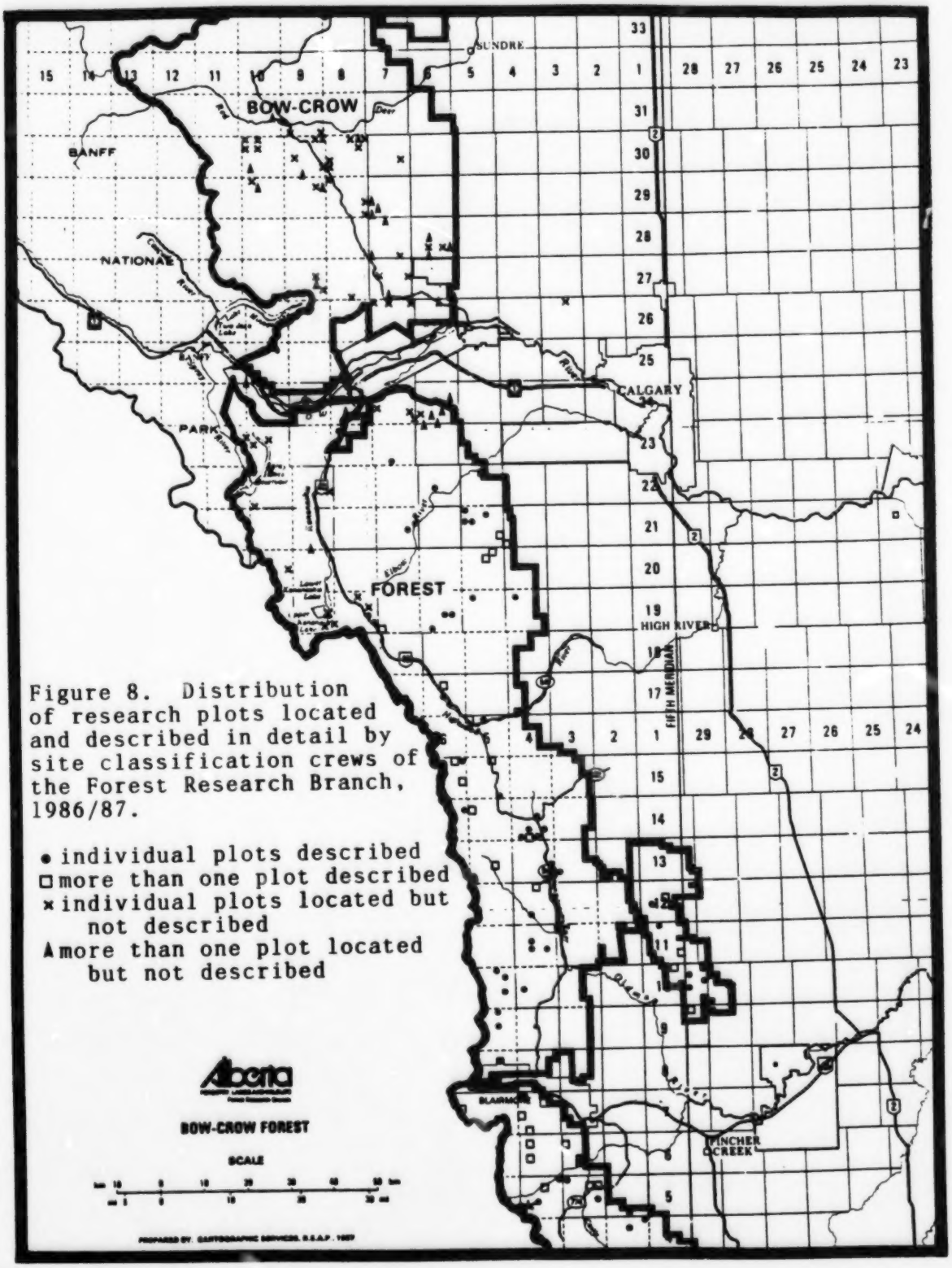


Figure 8. Distribution of research plots located and described in detail by site classification crews of the Forest Research Branch, 1986/87.

- • individual plots described
- □ more than one plot described
- × individual plots located but not described
- ▲ more than one plot located but not described

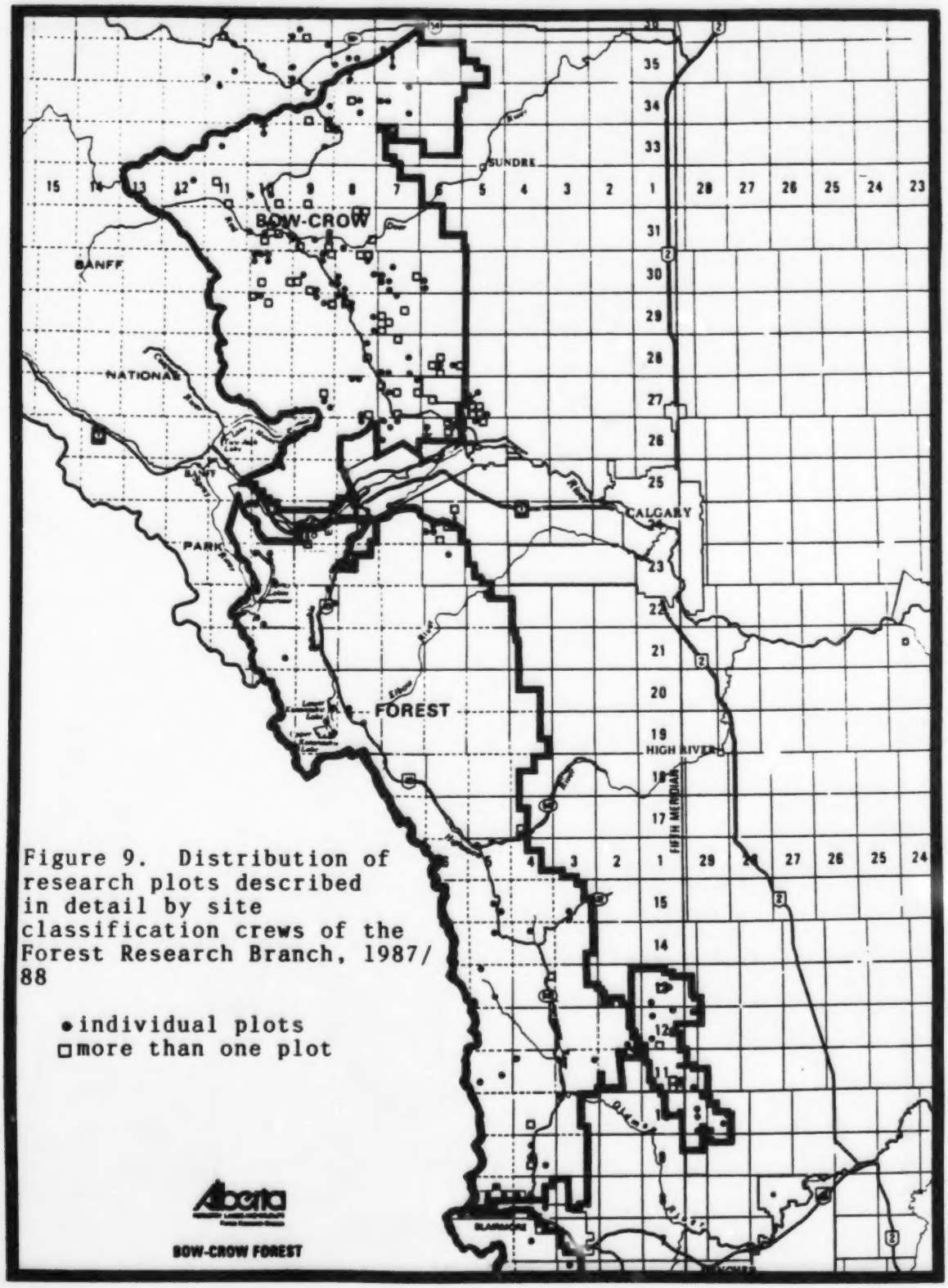


Figure 9. Distribution of research plots described in detail by site classification crews of the Forest Research Branch, 1987/88

• individual plots
□ more than one plot

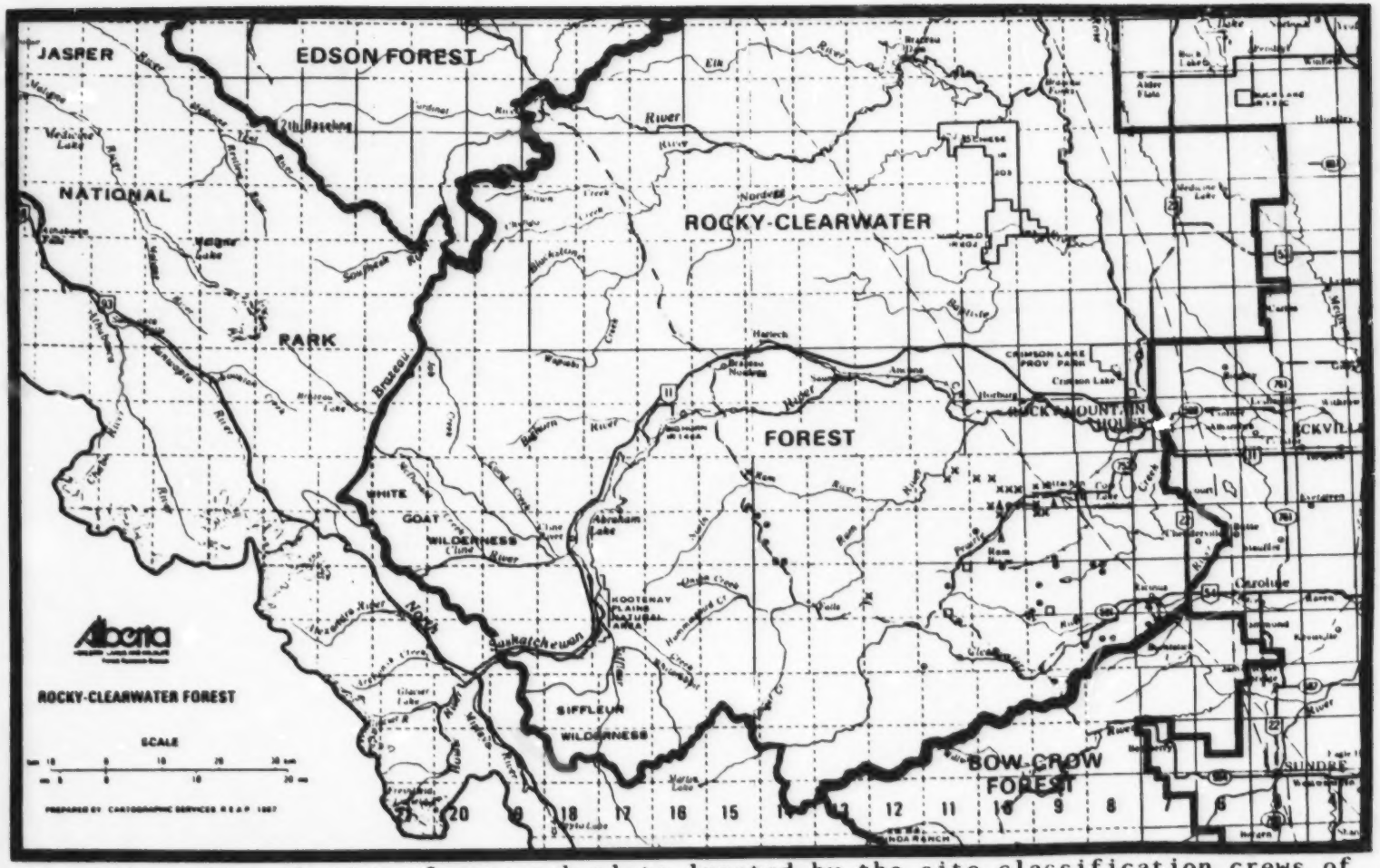


Figure 10. Distribution of research plots located by the site classification crews of the Forest Research Branch, AFS (individual plots described: (•); more than one plot described: (□); individual plots located but not described: (×); several plots located but not described: (▲)).

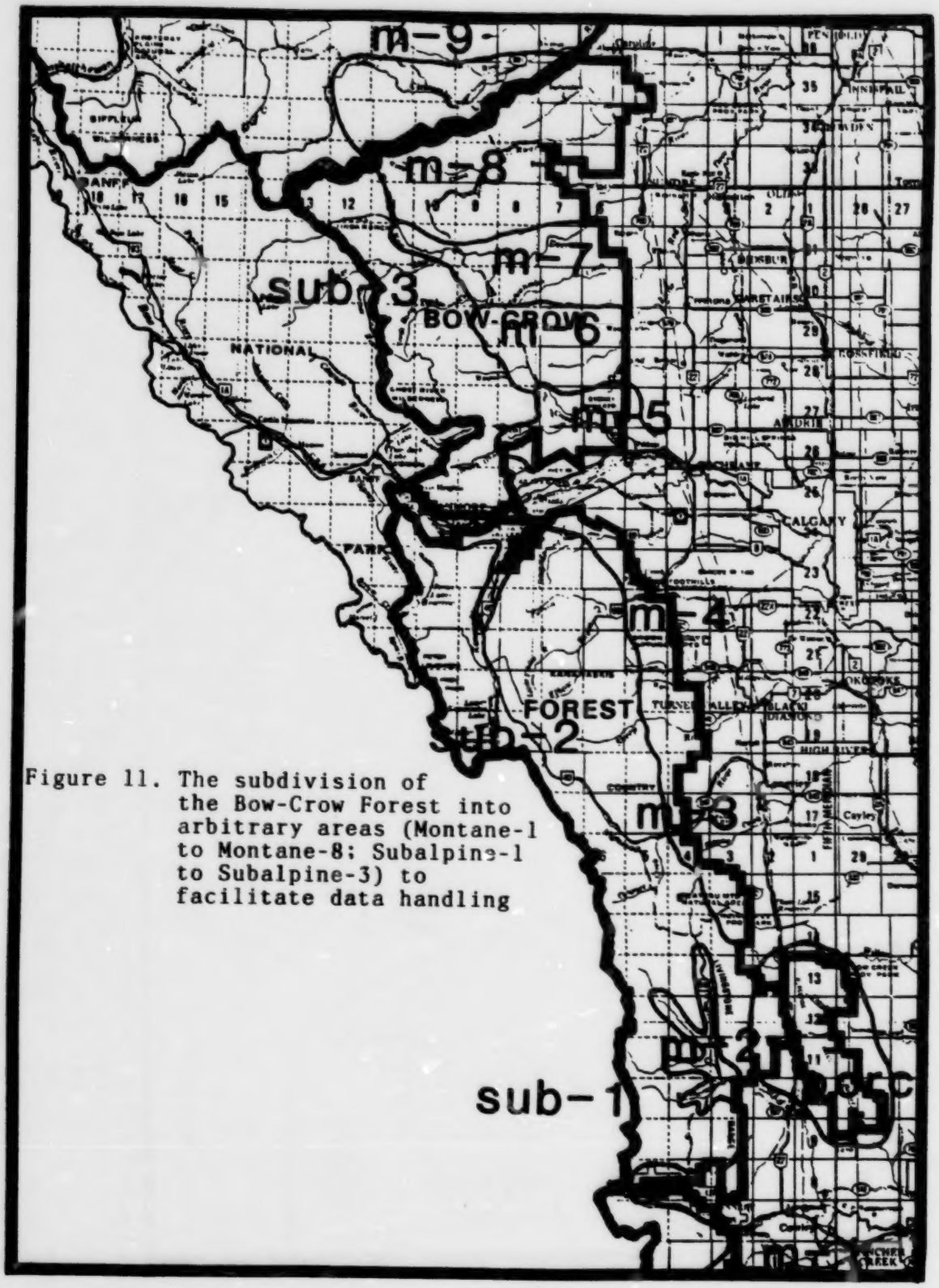
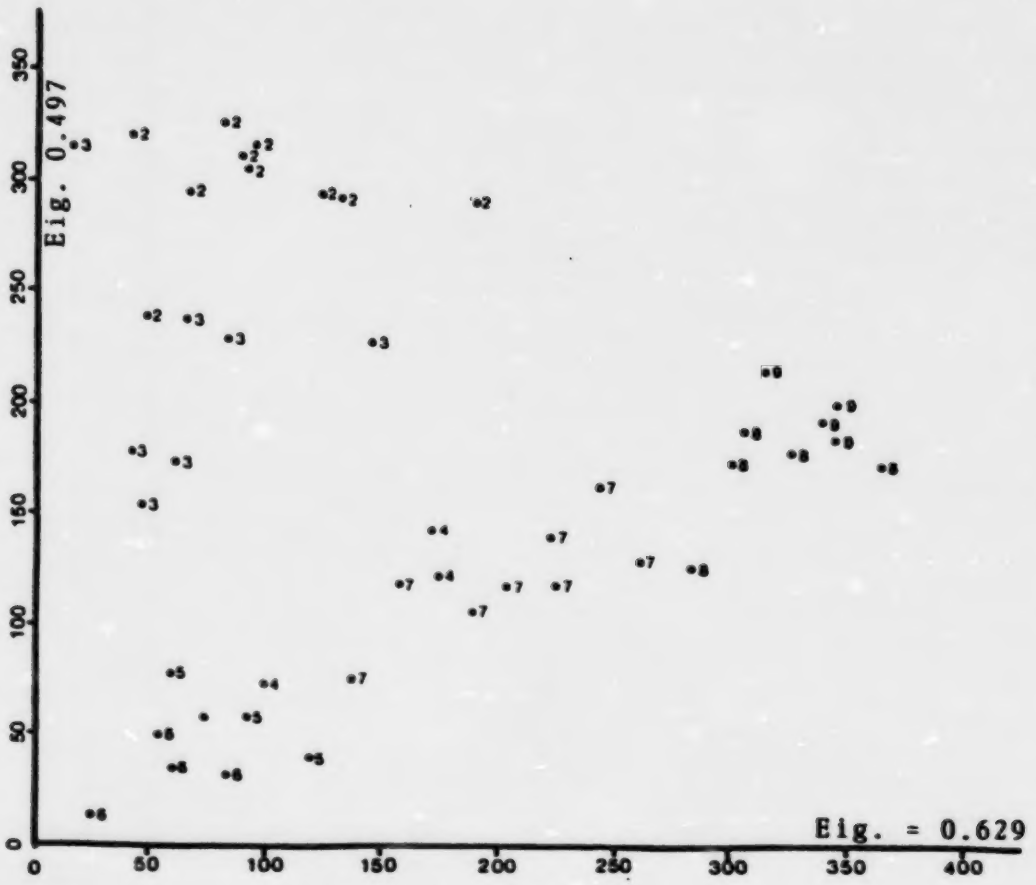


Figure 11. The subdivision of the Bow-Crow Forest into arbitrary areas (Montane-1 to Montane-8; Subalpine-1 to Subalpine-3) to facilitate data handling

Figure 12. Ordination of forest ecosystems in the geographic area designated as Montane-5.



2. Douglas - fir - Grass
3. Douglas - fir - Moss
4&7. Pine - Elymus - Shepherdia
5. Spruce - P - Moss
8&9. Aspen - (P-S) - Grass

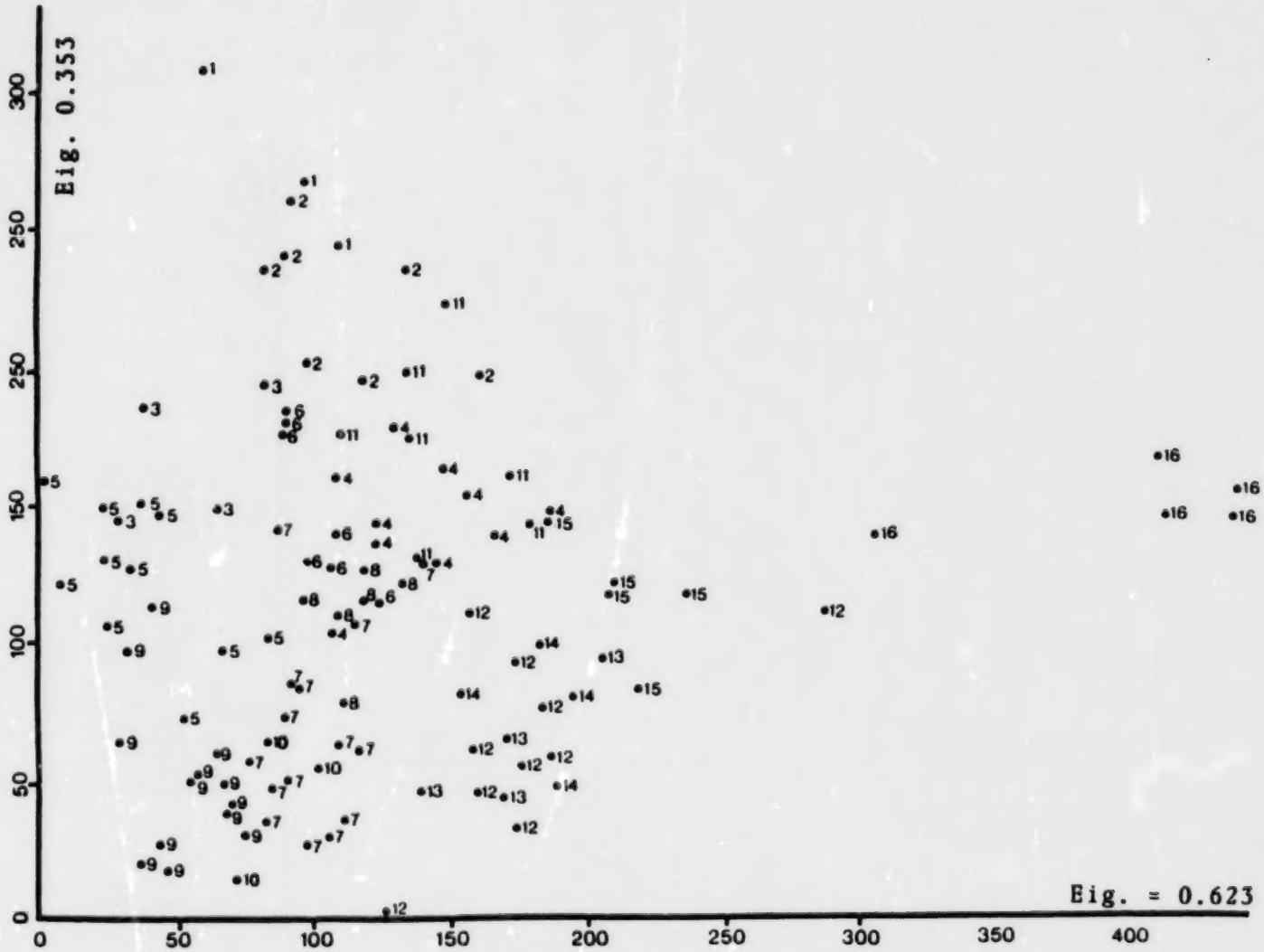


Figure 13. Research plots ordinated into similar groups along axes and 2 using the DECORANA program. Dots marked with the same number denote plots similar in terms of vegetation.

3.3.3 Development of data management systems

Significant progress has been made in our data analysis capability, using vegetation, soil and site data. Data formatting was developed with conversion routines to enable the analysis of the same data base with different programs. In addition, a special program to analyze mensuration data was developed for the site classification program of the Forest Research Branch by Dr. R. Yang of CFS. A sample of the output is shown in Table I.

3.3.4 Soil temperature monitoring

We also attempted to characterize forest ecosystems by monitoring soil temperature levels at 20, 50 and 100 cm depths. The purpose of the project was to determine soil temperatures of zonal sites of Douglas-fir, Montane, Subalpine and Boreal Zones. This project, if continued, could provide the data for growing season heat units on zonal and azonal sites of the above zones. This data would also be a valuable component of growth-predicting equations. The distribution of the thermistors and the two CR21 units are shown in Figure 14.

Examples of temperature data at several soil depths, using the CR21s, are shown in Figures 15. Each CR21 is installed at very similar stand elevation and aspect conditions, one near the Livingston River and the other on the Porcupine Hills. The objective was to study seasonal soil temperature levels as possible indices of zonal climate. It is apparent that soil temperature, measured at 50 cm depth, is consistently higher on the Porcupine hills than in the Livingstone River Valley. The cooler valley was classified as Subalpine Ecoregion by Strong and Leggat (1981) and as Montane Zone by Kojima (1980). Further analyses of this and other thermistor data from higher elevations, combined with vegetation data, will facilitate the delineation of zones and subzones. The analyses of the data is in progress. To date only a small portion of our data has been analyzed, therefore no clear conclusion can be drawn regarding conflicting boundaries of small-scale classification units proposed by several investigators.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the field research data, collected by crews of the Forest Research Branch (1986/88),the joint site classification effort of the Alberta Forest Service - Canadian Forestry Service (1976-81) the cooperative efforts of REAP and the Forest Research Branch, AFS in the Sundre area (Annas et al 1983) and other research results, an ecosystem guide is being developed for the Bow-Crow Forest. The first approximation of the guide will be completed within the current fiscal year, and will undergo field testing by field staff. Since this product is not an end in

Table I Computer output of the mensuration program developed by Dr. R. Yang of CFS for the Site Classification Program, Forest Research Branch, AFS

Statistics for Plot No. B7301 by species

Species	FA	FB	BW	FD	LA	LT	PF	PL	PW	AW	PB	SB	SE	SW	BC	BD	Total
Avg age	0.	0.	0.	0.	0.	0.	0.	60.	0.	0.	0.	0.	0.	72.			
Stem/ha	0.	0.	0.	0.	0.	0.	0.	800.	0.	150.	0.	0.	0.	100.	100.	150.	1050.
Percent	.00	.00	.00	.00	.00	.00	.00	76.19	.00	14.29	.00	.00	.00	9.52			
Avg dbh	.00	.00	.00	.00	.00	.00	.00	21.58	.00	10.90	.00	.00	.00	22.30			
BA/ha	.00	.00	.00	.00	.00	.00	.00	31.19	.00	1.46	.00	.00	.00	4.10			36.75
Gr vol	.00	.00	.00	.00	.00	.00	.00	240.60	.00	5.40	.00	.00	.00	26.28			272.28
Decay V	.00	.00	.00	.00	.00	.00	.00	.00	.00	1.09	.00	.00	.00	.00			1.09
Net vol	.00	.00	.00	.00	.00	.00	.00	240.60	.00	4.31	.00	.00	.00	26.28			271.19
Distribution of decay volume by species and crown class																	
Domin.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00			.00
Co-dom.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00			.00
Interm.	.00	.00	.00	.00	.00	.00	.00	.00	.00	1.06	.00	.00	.00	.00			1.06
Suppre.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03	.00	.00	.00	.00			.03

Avg height = 13.39 m. Dominant ht = .00 m; Co-dom. ht = 16.20 m; Intermed = 12.68 m; Suppressed = 7.10 m.

M.A.I. = 3.78 cu.m/ha/yr.

Site Index: SW = 16.7 m; PL = 16.6 m at index age 70 yrs

Distribution of gross, decay, and net volume by crown class

	Dominant	Co-dominant	Intermediate	Suppressed
Gr. vol	.00	185.48	82.22	4.58
%	.00	68.12	30.20	1.68
Decay vol	.00	.00	1.06	.03
%	.00	.00	.39	.01
Net vol	.00	185.48	81.16	4.55
%	.00	68.39	29.93	1.68

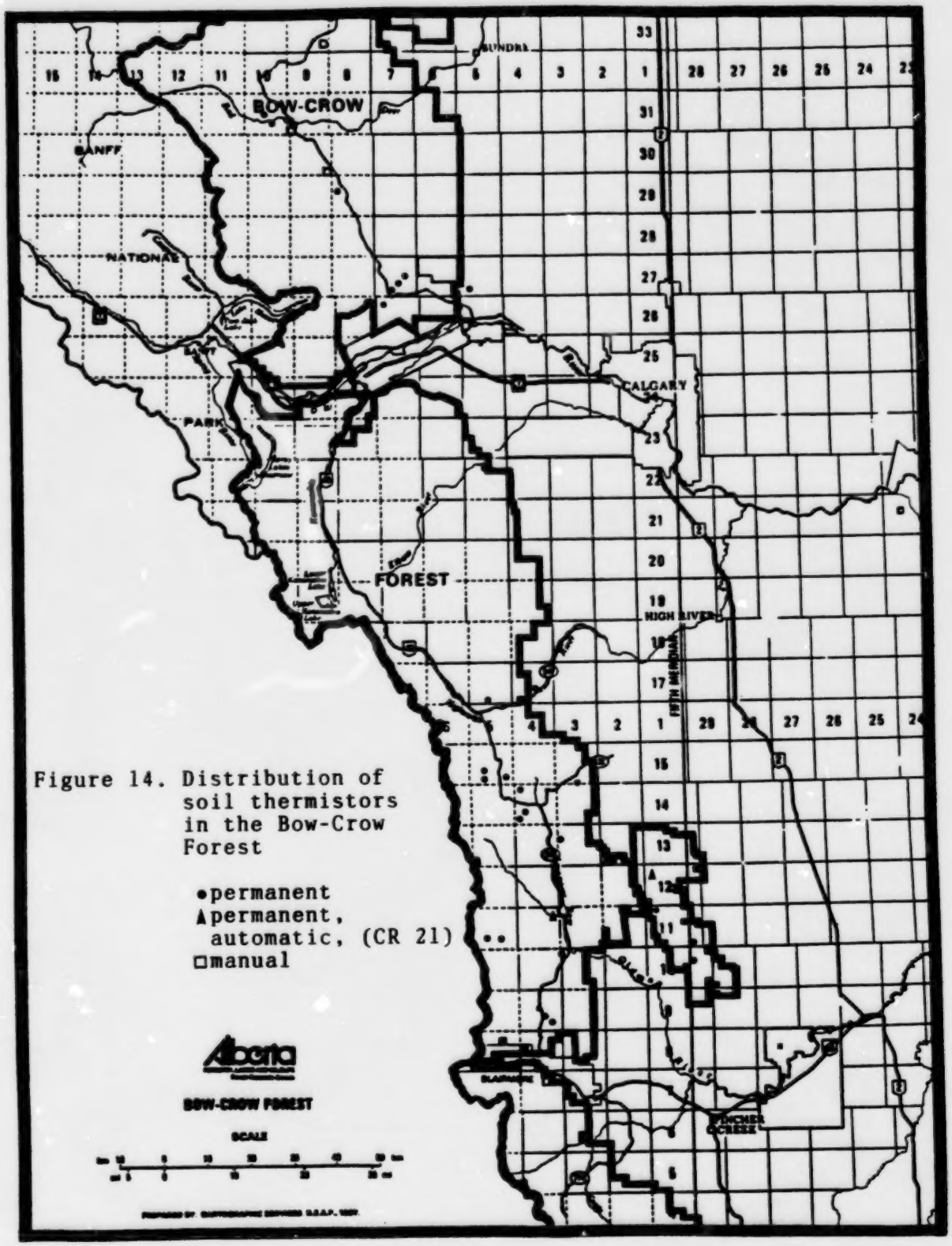


Figure 14. Distribution of soil thermistors in the Bow-Crow Forest

•permanent
▲permanent, automatic, (CR 21)
□manual

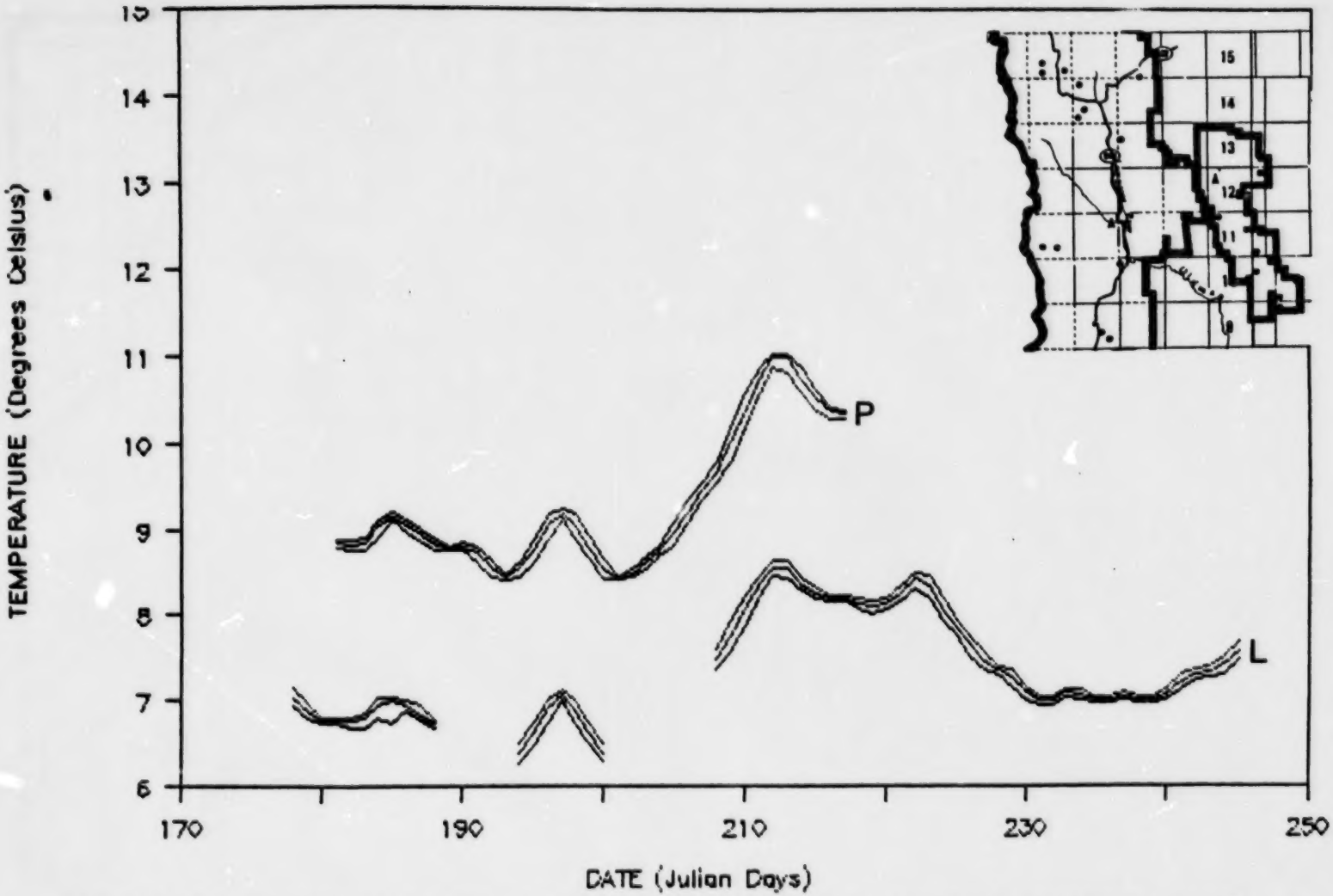


Figure 15. Daily mean soil temperature levels recorded by two CR21 stations located on modal sites in the Porcupine Hills (P) and the Livingston River Valley (L). The Porcupine Hills were classified as Douglas-fir Zone and Montane Ecoregion by Kojima (1980) and Strong and Legatt (1981) respectively.

itself, it is recommended that it be continuously refined based on feed-back from field staff. Using this cooperative approach the field guide will continue to grow to meet resource management needs as they arise.

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